AMENDMENTS TO THE CLAIMS

I claim:

1. (currently amended) A ~~Method~~ method for dynamically ~~optimize~~ optimizing data throughput at ~~the~~ radio interfaces of a packet data cellular network, said interfaces comprising ~~having at disposal of said interfaces~~ one or more types of modulations having different immunity from transmission errors when used for transmitting bursts of data, said data being packed-up in blocks~~,~~ between mobile stations ~~(MS)~~ and ~~the~~ serving base station ~~(BTS),~~ and vice versa, comprising the steps of:

- obtaining for each available modulation at least one of an upgrade and~~/or~~ a downgrade tabulated threshold of the Block Error Rate~~, or BLER,~~ delimiting a range in which ~~that~~ the available modulation outperforms ~~the~~ other available modulations in terms of net data throughput;

- averaging and comparing the ~~BLER~~ Block Error Rate, substantially continuously, ~~on~~ of the relevant temporary connection ~~being continuously averaged and compared~~ with the tabulated thresholds for selecting the proper modulation; ~~**characterized in that** includes the steps of:~~

- combining each available modulation with two or more coding schemes thereby obtaining ~~as~~ many modulation-and-coding schemes~~, termed hereinafter MCSs,~~ with different protection against transmission errors;

– obtaining for each ~~MCS~~ modulation and coding scheme at least one of a first upgrade and~~/or~~ a first downgrade tabulated ~~BLER~~ Block Error Rate threshold which is ~~(A)~~ valid for low-diversity ~~RF~~ radio frequency channels, delimiting a range in which the modulation and coding scheme ~~that MCS~~ outperforms the other available modulation and coding schemes in terms of net data throughput, and considering as low-diversity a channel without frequency hopping and with low user mobility;

– obtaining for each modulation and coding scheme~~MCS~~ at least one of a second upgrade and~~/or~~ a second downgrade tabulated ~~BLER~~ Block Error Rate threshold ~~(B)~~which is valid for high-diversity ~~RF~~ radio frequency channels, delimiting a range in which ~~that MCS~~the modulation and coding scheme outperforms the other available modulation and coding schemes in terms of net data throughput, and considering as high-diversity a channel characterized by frequency hopping or high user mobility;

– selecting either the first ~~(A)~~ or the second ~~(B)~~ tabulated thresholds according to ~~the~~ diversity of the ~~RF~~ radio frequency channel which sustains ~~the~~ a temporary connection; and

– ~~use~~ using the selected thresholds for discriminating ~~the~~ a right modulation and coding scheme~~MCS~~.

2. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 1, ~~characterized in that~~ wherein the step of discriminating ~~the~~ a right modulation and coding scheme~~MCS~~ ~~is performed by~~further comprises the steps of:

- updating, at each new incoming block of data, an averaged value of ~~BLER~~ Block Error Rate evaluated in correspondence of ~~the~~ an actual modulation and coding scheme~~MCS~~;
- comparing ~~said~~ the averaged ~~BLER~~ Block Error Rate with the at least one of the upgrade and~~/or~~ downgrade thresholds of the actual modulation and coding scheme~~MCS~~;
- replacing the actual modulation and coding scheme~~MCS~~ with ~~the MCS~~a modulation and coding scheme immediately less error protected when the averaged ~~BLER~~ Block and Error Rate is lower than ~~said~~ the upgrade threshold; or
- replacing the actual modulation and coding scheme~~MCS~~ with the modulation and coding scheme~~MCS~~ immediately more error protected when the averaged ~~BLER~~ Block and Error Rate is higher than ~~said~~ the downgrade threshold.

3. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 1, ~~characterized in that includes~~ further comprising the steps of:

- ~~-~~obtaining for each modulation and coding scheme~~MCS~~ at least one of a third upgrade and~~/or~~ third downgrade tabulated ~~BLER~~ Block Error Rate thresholds ~~(C)~~ valid for both low-diversity channels and incremental redundancy active, and
- delimiting a range in which ~~that MCS~~the modulation and coding scheme outperforms the other available modulation and coding scheme~~MCS~~s in terms of net data throughput.

4. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 1, ~~characterized in that includes~~ further comprising the steps of:

- -obtaining for each modulation and coding scheme~~MCS~~ at least one of a fourth upgrade and~~/or~~ downgrade tabulated ~~BLER~~ Block Error Rate thresholds ~~(D)~~ valid for both high-diversity channels and incremental redundancy active~~,~~, and
- delimiting a range in which ~~that MCS~~the modulation and coding scheme outperforms the other available modulation and coding scheme~~MCS~~s in term of net data throughput.

5. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 3, ~~characterized in that~~ wherein ~~the~~ a receiving entity ~~carries out~~ performs the steps of:

– temporarily storing errored data blocks in a memory buffer for joint decoding ~~them~~ with new transmissions of original blocks according to ~~the~~ an incremental redundancy technique; and

– continuously checking a condition of buffer full and other causes making retransmission with incremental redundancy inapplicable, for building a status variable~~, named hereinafter IR_status,~~ -which measures ~~the~~ an averaged status of the incremental redundancy.

6. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to ~~the preceding claim when it depends on~~ claim ~~3~~5, ~~characterized in that~~wherein for each modulation and coding scheme~~MCS~~ a linear interpolation is performed run-time between at least one of the first ~~(A)~~ and third ~~(C)~~ upgrade thresholds and~~/or~~ between the first ~~(A)~~ and third ~~(C)~~ downgrade thresholds, using the ~~IR_status~~status variable as interpolating factor for unbalancing the entity of the interpolation either towards third thresholds ~~(C)~~ when incremental redundancy prevails, or towards first thresholds ~~(A)~~ ~~on~~ in a ~~the~~ contrary case.

7. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 5, ~~characterized in that~~wherein for each modulation and coding scheme~~MCS~~ a linear interpolation is performed run-time between at least one of the second ~~(B)~~ and fourth ~~(D)~~ upgrade thresholds and~~/or~~ between the second ~~(B)~~ and fourth ~~(D)~~ downgrade thresholds, using the ~~IR_status~~status variable as interpolating factor for unbalancing the entity of the interpolation either towards fourth thresholds ~~(D)~~ when incremental redundancy prevails, or towards second thresholds ~~(B)~~ ~~on~~in the contrary case.

8. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 5, ~~characterized in that~~ wherein the averaged status of the incremental redundancy is obtained by:

- ~~-~~weighting both ~~the~~ a preceding and ~~the~~ an actual values of a variable~~, named hereinafter IR_check~~,
- taking value 1 if incremental redundancy is properly working, ~~or~~ and value 0 for~~on~~ the contrary, and
- using a digital filter having a pulse response exponentially decreasing with discrete time n spanning a data block period.

9. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 1, ~~preceding claims, characterized in that~~ wherein ~~said~~ the averaged value of ~~BLER~~ Block Error Rate is obtained by weighting both ~~the~~ preceding values of ~~BLER~~ Block Error Rate and ~~the~~ actual decisions on errored blocks, using a digital filter having a pulse response exponentially decreasing with discrete time n spanning a block period.

10. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 9, ~~characterized in that~~ wherein the pulse response of ~~said~~ the digital filter of ~~BLER~~ Block Error Rate is obtained by summing ~~up~~ two weight functions both accepting samples with ~~the~~ a commanded modulation and coding scheme~~MCS~~, a first one to weigh the preceding values of ~~BLER~~ Block Error Rate and the second one to weigh the actual decisions on errored blocks.

11. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 10, ~~characterized in that~~ wherein ~~said~~ the first and second weight functions have balanced weights, so that an arbitrary increasing of ~~the~~ a weight of the first function also involves an equal decreasing of the weight of the second function, and vice versa.

12. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 11, ~~characterized in that~~ wherein the weight of ~~said~~ the first and second weight functions are both equally varied in order to compensate ~~the~~ a missing filtering effect of possible lacking blocks, in that making ~~the~~ an outlined pulse response possible.

13. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 12, ~~characterized in that the variation of said~~wherein the first and second weights are carried out by making the ~~said~~ first and second weight functions further depending on a reliability function which tracks ~~the~~ an age of the received blocks.

14. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 10, ~~characterized in that said~~wherein the temporary connection is dedicated to transfer packet data from a selected mobile station to the base station, and ~~said~~ the pulse response of ~~BLER~~ Block Error Rate digital filter is obtained ~~by means of the following function~~according to the function:

$$BLER_n = f_1(BLER_{n-1}) + f_2(s_n)$$

wherein:

- n is ~~the~~ an iteration index spanning one block period;
- $s_n = 0$ if ~~the~~ a block at instant n has been correctly received;
- $s_n = 1$ if ~~the~~ a block at instant n has not been correctly received;
- $s_n = \frac{1}{K}\sum_{k=1}^{K} s_{n,k}$ if K blocks are received for ~~the~~ a considered connection;
- $f_1(BLER_{n-1})$ is ~~said~~ the first weight function, taking values inside ~~the~~ an interval 0 - 1; and
- $f_2(s_n)$ is ~~said~~ the second weight function of the variable s_n relative to ~~the~~ a decision on the errored blocks, taking values inside the interval 0 – 1.~~;~~

15. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to ~~the preceding~~ claim 14, ~~characterized in that said~~wherein the first and second weight functions ~~assume~~ comprise the following expressions:

$$f_1(BLER_{n-1}) = (1 - \beta \cdot \frac{x_n}{R_n}) \cdot BLER_{n-1}$$

$$f_2(s_n) = \beta \cdot \frac{x_n}{R_n} \cdot s_n$$

wherein:

- x_n is equal to 1 if "at least" one RLC block for ~~the~~ a considered connection with ~~the~~ a commanded MCS is received at time instant n, otherwise is set to 0;

- $\beta = 1/T_{AVG}$ is a forgetting factor and T_{AVG} being ~~the~~ a filtering period in multiples of a radio block; and
- $R_n = (1-\beta)\cdot R_{n-1} + \beta\cdot x_n;\ R_{-1} = 0$ is said reliability function.

16. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 8, ~~characterized in that said~~wherein the temporary connection is dedicated to transfer packet data from a selected mobile station to the base station, and said pulse response of the digital filter of the ~~IR_status~~status variable is obtained ~~by means of~~ according to the following function:

$$IR\_status_n = f_1(IR\_status_{n-1}) + f_2(IR\_check_n)$$

wherein:

- n is ~~the~~ an iteration index spanning one block period; and
- f_1 and f_2 are weight functions ~~following the~~according to same laws as used in the Block Error Rate ~~BLER~~ calculation.

17. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 16, ~~characterized in that said~~wherein the first and second weight functions ~~assume~~ comprise the following expressions:

$$f_1(IR\_status_{n-1}) = (1 - \beta\cdot\frac{x_n}{R_n})\cdot IR\_status_{n-1}$$

$$f_2(IR\_check_n) = \beta\cdot\frac{x_n}{R_n}\cdot IR\_check_n$$

wherein: R_n takes a formal expression as that used in the ~~BLER~~ Block Error Rate calculation, while x_n and β are the same.

18. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 6, ~~characterized in that~~wherein ~~said~~ the linear interpolations ~~take~~ comprise the following expressions:

$UP\_th_n = (1 - IR\_status_n) \times BLER_{MCSx \to MCSy} + IR\_status_n \times BLER_{MCSx\_wIR \to MCSy\_wIR}$

$DN\_th_n = (1 - IR\_status_n) \times BLER_{MCSx \to MCSz} + IR\_status_n \times BLER_{MCSx\_wIR \to MCSz\_wIR}$

wherein:

- UP_th_n and DN_th_n are ~~the~~ an upgrade and downgrade thresholds, respectively, at ~~the~~ an n-th block period;
- $BLER_{MCSx \to MCSy}$ is an upgrade first (A) or second (B) tabulated threshold;
- $BLER_{MCSx\_wIR \to MCSy\_wIR}$ is an upgrade third (C) or fourth (D) tabulated threshold;

- $BLER_{MCSx \rightarrow MCSz}$ is a downgrade first (A) or second (B) tabulated threshold;
- $BLER_{MCSx\_wIR \rightarrow MCSz\_wIR}$ is a downgrade third (C) or fourth (D) tabulated threshold.

19. (Currently Amended) ~~Method~~ The method ~~for dynamically optimizing data throughput~~ according to claim 10, ~~characterized in that~~wherein ~~said~~ the temporary connection is dedicated to transfer packet data from the base station to a selected mobile station, and ~~said~~ the pulse response of ~~BLER~~ Block Error Rate digital filter is obtained ~~by means of~~ according to the following function:

$$BLER_k = f_1(BLER_{k-1}) + f_2(s_k)$$

wherein:

- k is ~~the~~ a reporting instant lasting m blocks;
- $s_k = \frac{Nack\_blocks}{Sent\_blocks}$

  Nack_blocks: number of badly received blocks among those sent with ~~the~~a present MCS;

  Sent_blocks: number of blocks sent with ~~the~~ a present MCS in ~~the~~ a previous polling period:
- $f_1(BLER_{k-1})$ is ~~said~~ the first weight function, taking values inside ~~the~~ an interval 0 - 1; and
- $f_2(s_k)$ is ~~said~~ the second weight function of the variable s_k relative to the decision on the errored blocks, taking values inside the interval 0 - 1.

20. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 19, ~~characterized in that~~wherein ~~said~~ the first and second weight functions ~~assume~~ comprise the following expressions:

$$f_1(BLER_{k-1}) = (1 - \frac{\beta}{R_k}) \cdot BLER_{k-1}$$

$$f_2(s_k) = \frac{\beta}{R_k} \cdot s_k$$

wherein:

- $\beta = 1/T_{AVG}$ is a forgetting factor and T_{AVG} being ~~the~~ a filtering period in multiples of a radio block; and
- $R_k = (1-\beta)^m \cdot R_{k-1} + \beta; \quad R_{-1} = 0$ is said reliability function.

21. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 19, ~~characterized in that said~~wherein the temporary

connection is dedicated to transfer packet data from the base station to a selected mobile station, and ~~said~~ the pulse response of ~~IR_status~~the status variable digital filter is obtained ~~by means of~~according to the following function:

$$IR\_status_k = f_1(IR\_status_{k-1}) + f_2(IR\_check_k)$$

wherein:

- k is ~~the~~ a reporting instant lasting m blocks;
- f_1 and f_2 are weight functions following the same laws as used in the ~~BLER~~ Block Error Rate calculation.

22. (Currently Amended) ~~Method~~ The method ~~for dynamically optimizing data throughput~~ according to claim 21, ~~characterized in that said~~wherein the first and second weight functions ~~assume~~ comprise the following expressions:

$$f_1(IR\_status_{k-1}) = (1 - \frac{\beta}{R_k}) \cdot IR\_check_{k-1}$$

$$f_2(IR\_check_k) = \frac{\beta}{R_k} \cdot IR\_check_k$$

wherein: R_k takes a formal expression as that used in the ~~BLER~~ Block Error Rate calculation, and β is the same.

23. (Currently Amended) The ~~Method~~ method ~~for dynamically optimizing data throughput~~ according to claim 1, ~~characterized in that~~wherein a modified power control works in parallel with the modulation and coding scheme~~MCS~~ switching link adaptation and the modified power control includes the following steps:

– off-line calculation of the expression:

$$T_{PxTS} = T_P / N_{TS},$$

wherein: T_{PxTS} is ~~the~~ a Peak Throughput per timeslot; T_P is ~~the~~ a Peak Throughput derived from ~~the~~ a Quality of Service Class of the connection, and N_{TS} is ~~the~~ a minimum between ~~the~~ a number of allocable timeslots and ~~the~~ a number of timeslots that can be handled by the mobile station due to its multislot class;

– off-line mapping of the calculated T_{PxTS} on a simulated curve depicting ~~the~~ a maximum achievable net throughput in function of ~~the~~ values of Carrier versus Interference C/I, and obtaining from the curve a target C/I_{target} value; and

– exploiting the C/I_{target} for all ~~the~~ duration of the ongoing connection as a goal to be maintained by the network ~~(BSC, BTS)~~ exploiting the Power and Interference measures at ~~the~~ a receiver side.